Attention and Talker-Specificity in the Memory Encoding of Spoken Sentences

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Background

Talker-specific, ***acoustically-detailed*** memory for individual words.

(Bradlow et al., 1999; Goldinger, 1996; Palmeri et al., 1993)

- Better memory for ***same*** talker than ***different*** talker.
- Speech rate, intonation, emotion, extrinsic noise. . .

  (Bradlow et al., 1999; Nygaard & Queen, 2008; Pufahl & Samuel, 2014; Sheffert, 1998)

Memory is central to language understanding.

(Goldinger, 1998; Pierrehumbert, 2016; Wedel, 2012)

Problem

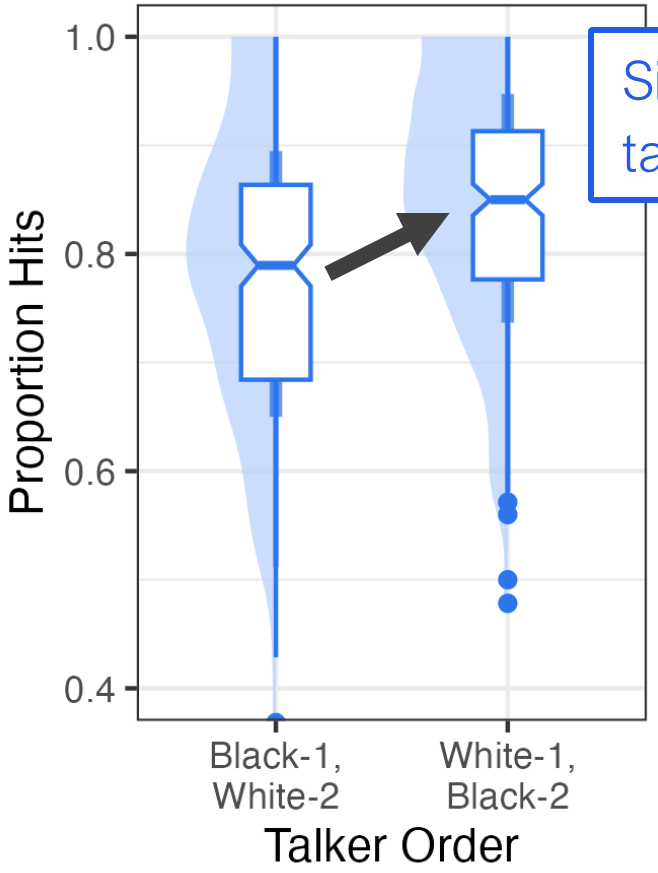
Most speech experiences are ***more complicated!***

- Longer utterances.
- Multi-tasking; planning responses.
- Talker information and messages interact in complex ways.

Fine-grained info is critical at the ***word level.***

How explanatory is this in ***longer utterance*** with ***various cognitive demands?***

Problem



Clapp, Vaughn, & Sumner, 2023

Simply swapping the order of talkers, memory patterns change.

***Memory Asymmetries**:* Some utterances are remembered better than others.

Asymmetries may result from ***resource allocation*** related to cognitive demands.

If specificity and memory asymmetries are ***fundamental*** to the system, they should be evident ***beyond the word.***

Question

How does dynamic resource allocation shape *linguistic representations?*

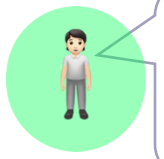
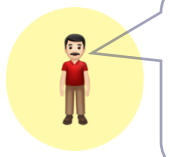
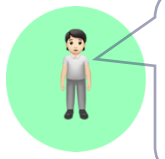
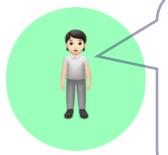
Is *talker-specific* information stored in memory for *full sentences*? (Exp. 1 – Validation)

What is the effect of *resource allocation* on memory for *talker-specific* information? (Exp. 1)

What is the effect of resource allocation on memory for sentences' *linguistic/conceptual* information? (Exps. 2 & 3)

Current study

Recognition Memory with *Full* or *Divided* Attention:

		Study		*Test*
Exp. 1	Audio sentences	 *"The front desk is attended by an elderly man."*	→ Audio	 *"The front desk is attended by an elderly man."*
Exp. 2	Audio sentences	 *"The front desk is attended by an elderly man."*	→ Text	The front desk is attended by an elderly man.
Exp. 3	Audio sentences	 *"The front desk is attended by an elderly man."*	→ Images	

How does resource allocation affect talker-specific memory for sentences?

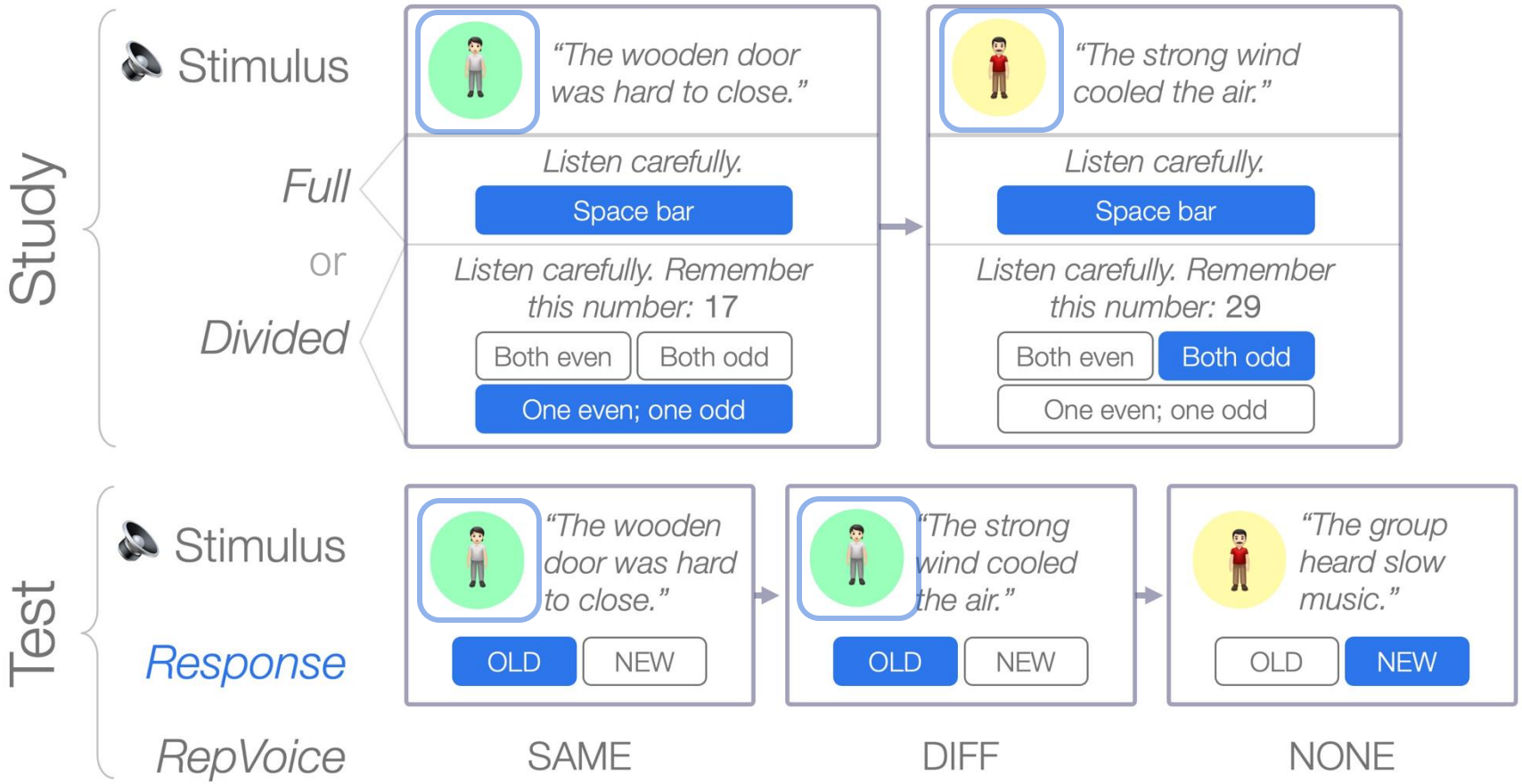
Design – Audio

Participants: From Prolific; Full (*N* = 163), Divided (*N* = 159).

Talkers: *2 female; 2 male GA speakers.*

Stimuli: *Basic English Lexicon sentence list (Rimikis, Smiljanic, & Calandruccio, 2013)*

RepVoice: *SAME vs. DIFF talker.*



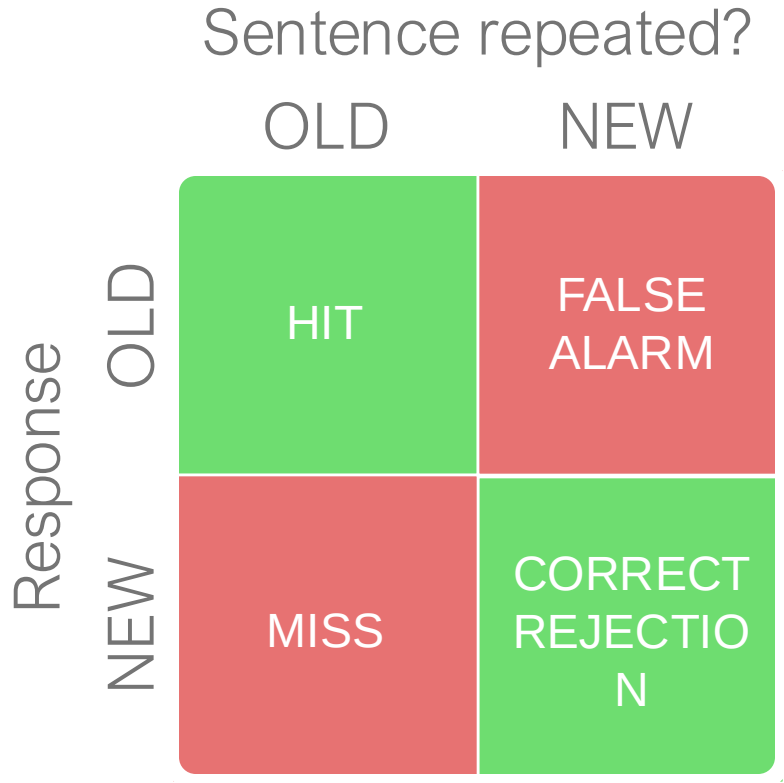
Analysis

Hits: OLD responses on OLD sentences.

False alarms: OLD responses on NEW sentences.

D': z(hits) – z(false alarms)

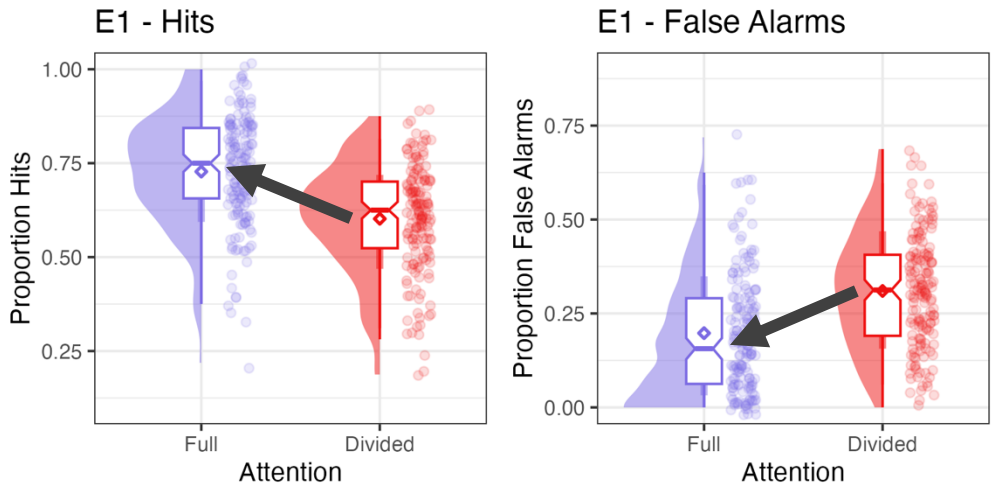
logRT: Log response time on Hits, measured from stimulus offset.

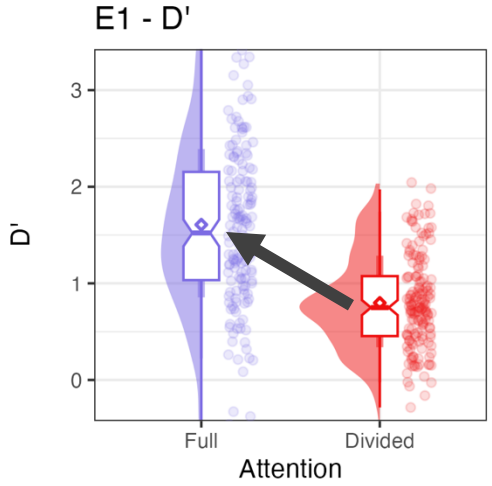


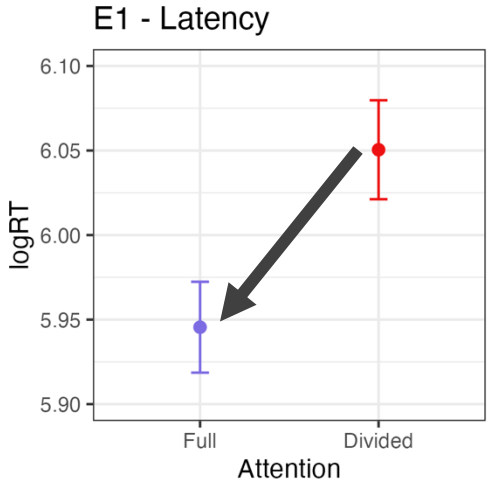
Results – Attention

More OLD sentences recognized in Full than Divided.
p < 0.001

Overall, more accurate in Full than Divided.
p < 0.001





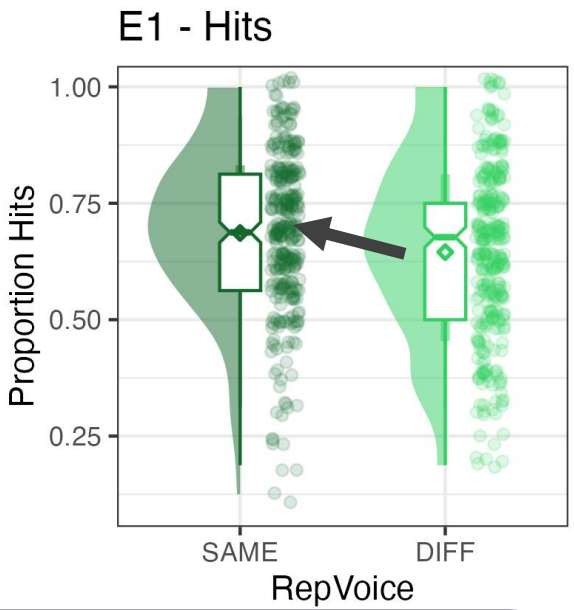


More incorrect responses on NEW trials in Divided than Full.
p < 0.001

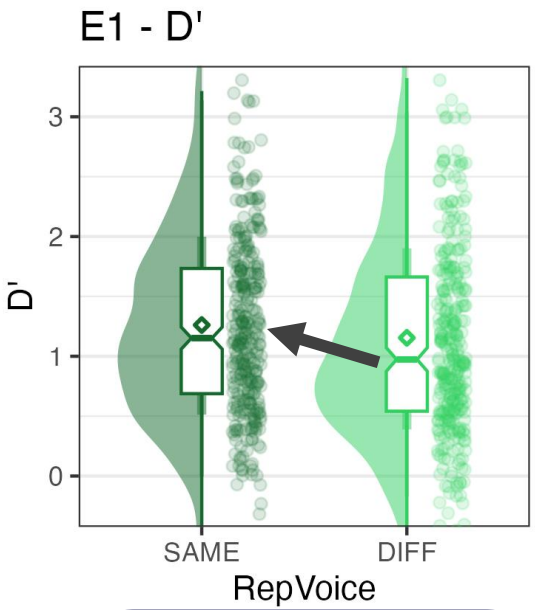
Correct responses *faster* in Full than Divided.
p < 0.05

logRT 6.1 = 445 ms
logRT 5.9 = 365 ms

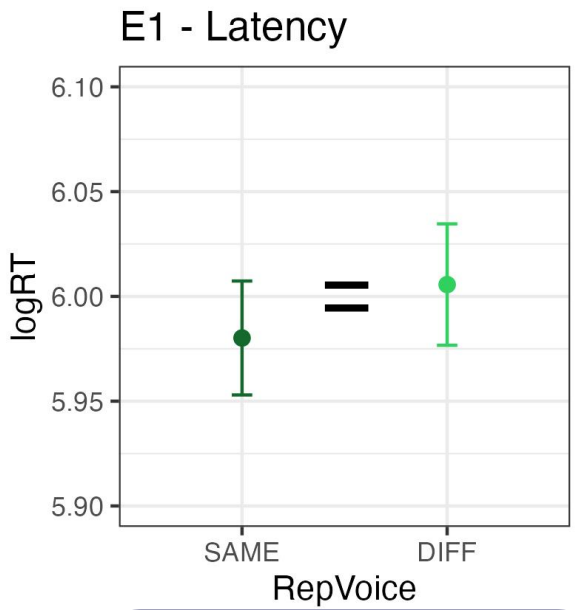
Results – RepVoice



More OLD sentences recognized when repeated by than SAME than by a DIFF talker.
p < 0.001



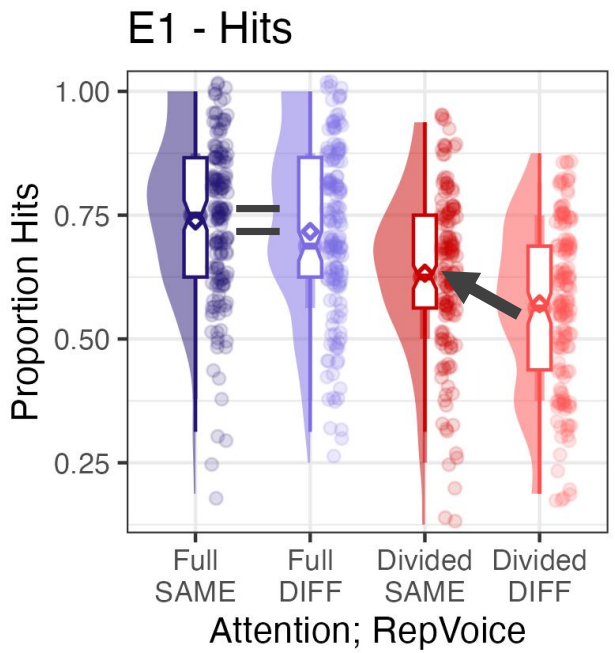
Holds after correcting for False Alarms.
p < 0.001



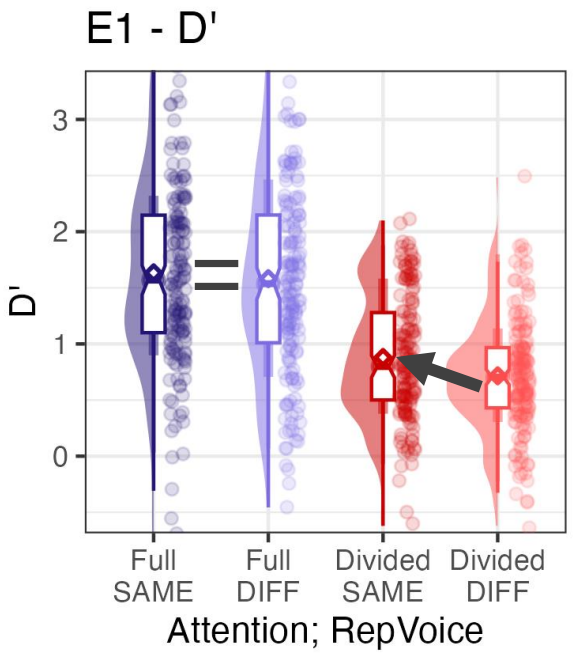
No RT advantage for SAME repetitions.
p > 0.01

logRT 6.1 = 445 ms
logRT 5.9 = 365 ms

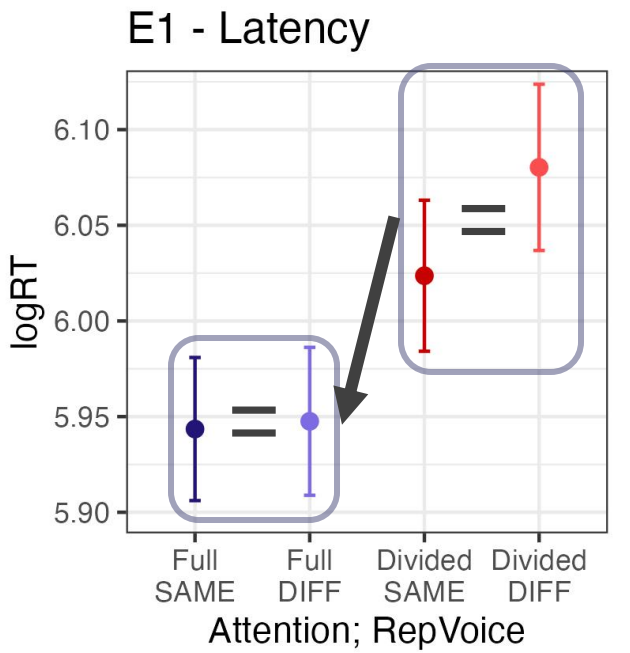
Results – Attention; RepVoice



Talker-specificity effect driven by Divided Attention. N.S. in Full.



This holds for D'.



No repVoice effect for RT.

logRT 6.1 = 445 ms
logRT 5.9 = 365 ms

How does attention at encoding affect retrieval when no acoustic cues are available?

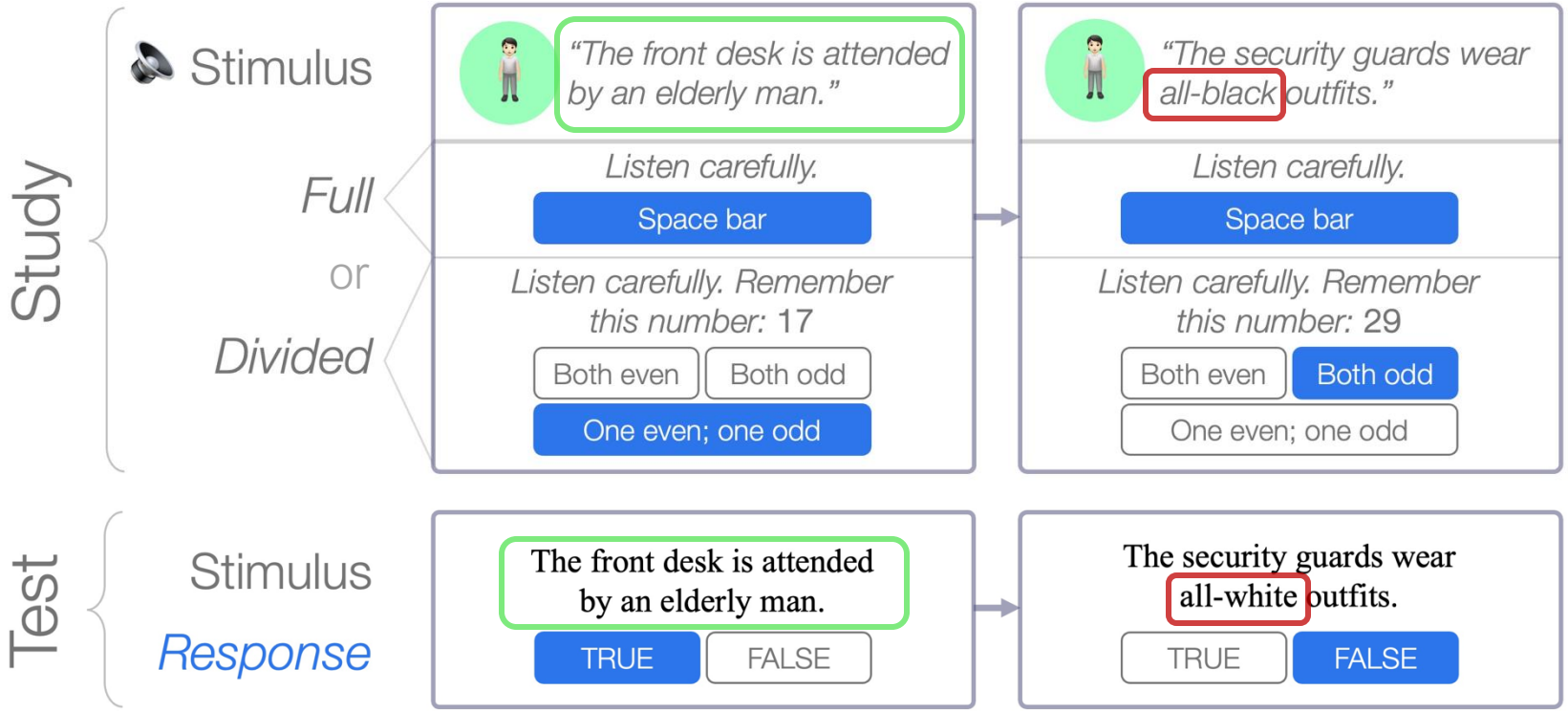
Design – Text

Full (*N* = 69)
Divided (*N* = 74)

Sentences in coherent frames: *Museum, Public Park, Train Station, Suburban Downtown.*

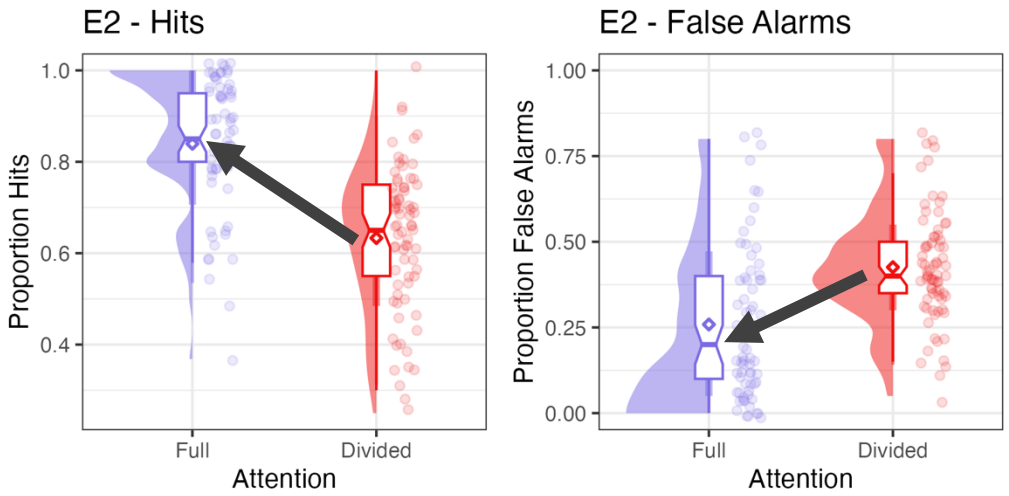
Ten semantically-opposed pairs per frame: *"The security guards wear all [black] / [white] outfits.*

Same 4 talkers. *(One per frame.)*



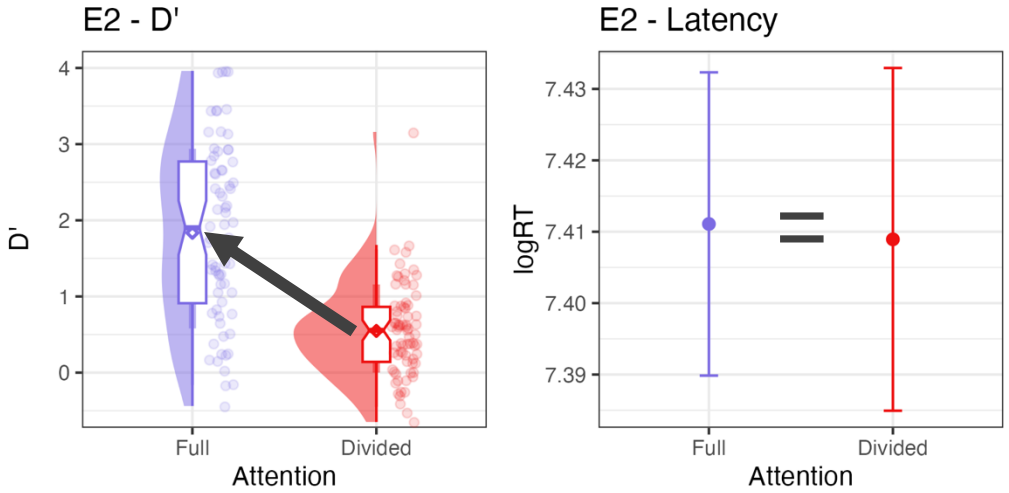
Results – Text Stimuli

More OLD sentences recognized in Full than Divided.
p < 0.001



More misidentified NEW trials in Divided than Full.
p < 0.001

Overall, more accurate in Full than Divided.
p < 0.001



No effect of attention on RTs.

logRT 7.43 = 1685 ms
logRT 7.39 = 1620 ms

How does attention at encoding influence memory for conceptual information?

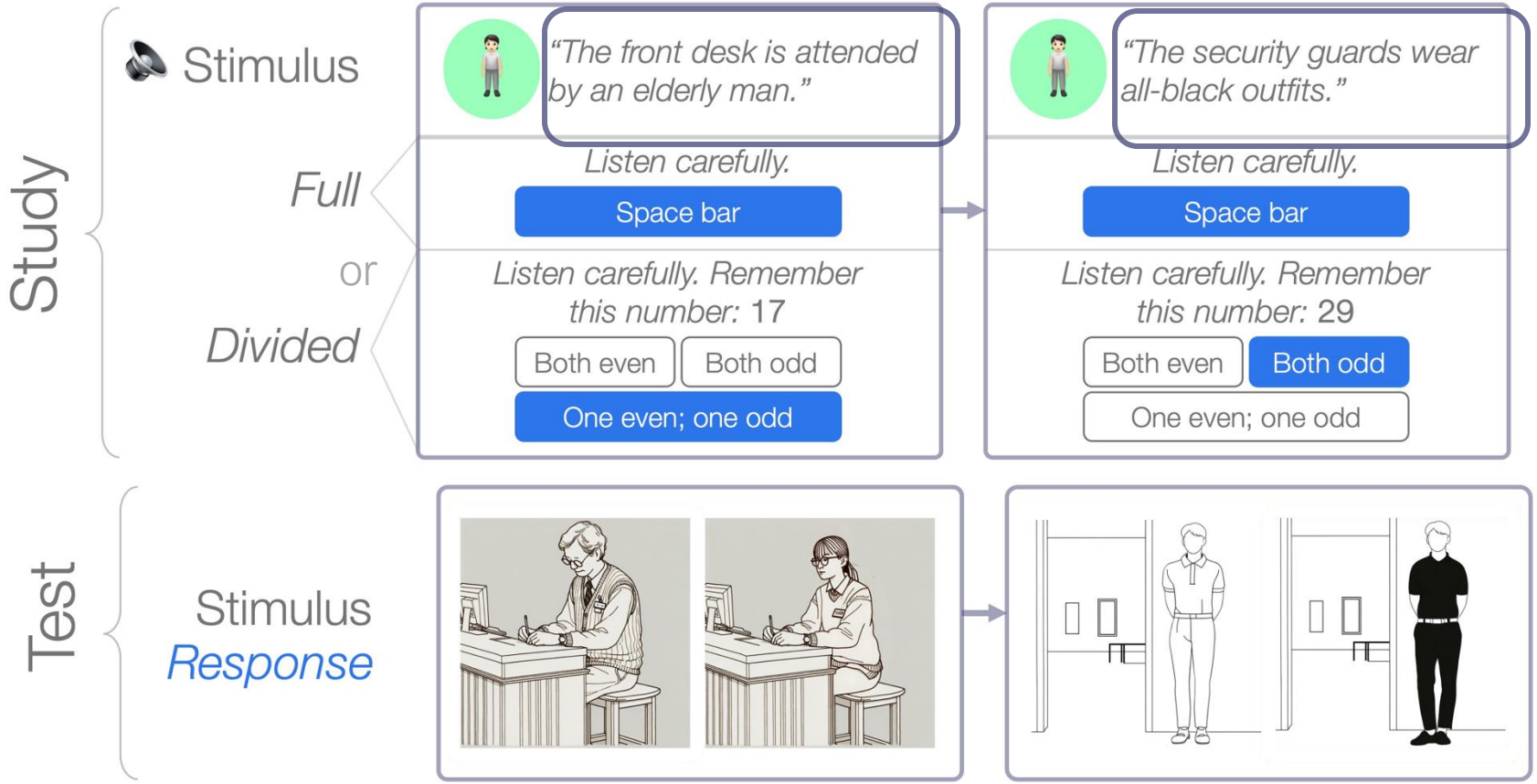
Design – Images

Full (*N* = 73)
Divided (*N* = 68)

Same study block as Exp. 2. *Same frames; same talkers.*

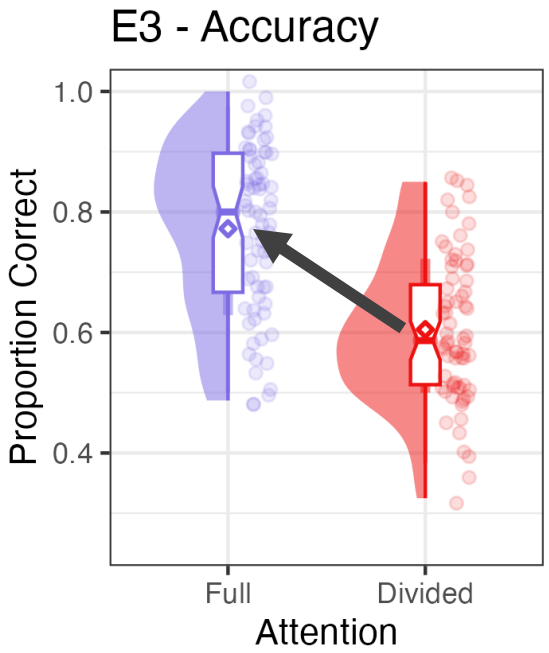
Both images presented each trial.

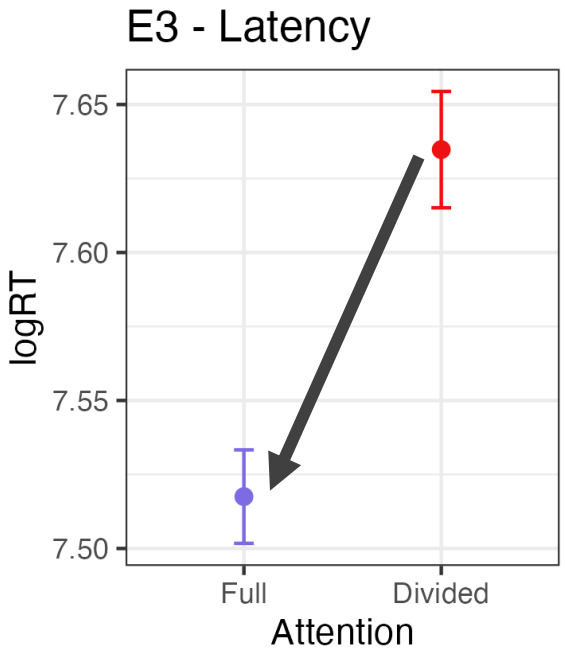
Analysis: Overall accuracy and logRT.
No traditional signal detection measures.



Results – Image Stimuli

More accurate in Full than Divided.
p < 0.001





Faster correct responses in Full than Divided.
p < 0.001

logRT 7.65 = 2100 ms
logRT 7.50 = 1808 ms

Discussion

Talker-specificity effects for ***spoken sentences.***

Effect is ***stronger*** for Divided than Full attention.

Fine-grained acoustic memory is ***fundamental*** to the system!

This info is ***not sacrificed*** when cognitive resources are scarce.

This type of encoding is ***not lexical.***

Discussion

Substantial differences across attention conditions in all Exps.

Downstream consequences of resource allocation: ***More robust*** representations of patterns we ***attentionally prioritize!***

On-the-fly resource allocation may help explain asymmetries frequency-based approaches can't account for.

*Memory for **longer utterances** is highly talker-specific!*

*Encoding of these utterances depends heavily on **resource allocation**, which likely shapes representations.*

Thank you!

Questions?
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sumner@stanford.edu

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National Science Foundation

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